

ARJUNA

JEE

LECTURE - 07

Mole Concept



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TABLE OF CONTENT



01 EMPIRICAL FORMULA

02 MOLECULAR FORMULA

03

04



Q.

A gaseous mixture contains 1 mole of CO_2 and 1 mole of N_2O . Average vapour density of mixture is:

44

44

A 44

C 19.45

10 Sec

B 21.65

☒ D none of these

$$\text{Avg. v.d.} = \frac{(\text{M.wt})}{2} \text{Avg.}$$

$$= \frac{44}{2} = \underline{\underline{22}}$$

$$(\text{M.wt})_{\text{Avg}} = \frac{\sum M_i X_i}{\sum X_i}$$

$$= \frac{M_1 X_1 + M_2 X_2}{X_1 + X_2} = \frac{1 \times 44 + 1 \times 44}{1 + 1}$$

$$= \underline{\underline{44}}$$



PERCENTAGE OF ELEMENT IN A COMPOUND

$$\% \text{ of element} = \frac{\text{total Mass of element}}{\text{Mass of Comp. or M.wt of Comp.}} \times 100$$

$$\begin{array}{r} \text{H}_2 = 2 \\ \text{S} = 32 \\ \text{O}_4 = 64 \\ \hline 98 \end{array}$$

Ex → Calculate % of 'S' atom in H_2SO_4

$$\text{Sol}^n \rightarrow \% \text{ of 'S'} = \frac{\text{total Mass of S}}{\text{M.wt of Comp.}} \times 100 = \frac{32 \times 1}{98} \times 100 = 32.65\%$$



$$\underline{C_{SD} = 21}$$

$$\textcircled{1} \text{ \% of element} = \frac{\text{Mass of element}}{\text{M.wt of comp.}} \times 100$$

(2) percentage de Kr, Question me kuchh Bhi puchha jaye, aap ko, bas formula use krna hai

(3) Minimum M.wt batao $\Rightarrow$ No. of atom = 1



Q.

The percentage weight of Zn in white vitriol [$\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$] is approximately equal to (at. mass of Zn = 65, S = 32, O = 16 and H = 1).

A 33.65%

B 23.65%

C 32.56%

☒ D 22.65%

$$\text{Zn} = 65$$

$$\text{S} = 32$$

$$4 \times \text{O} = 64$$

$$7\text{H}_2\text{O} = 18 \times 7$$

$$\underline{287}$$

$$\% \text{ of Zn} = \frac{\text{total mass of Zn}}{\text{m.wt of comp}} \times 100 = \frac{65 \times 1}{287} \times 100$$

$$= 22.64\%$$

Q. Calculate No. of water molecules present in $\text{ZnSO}_4 \cdot x\text{H}_2\text{O}$ comp., if 44% approx water present in comp.

(a) 5 (b) 2 (c) 7 (d) 4

Soln

$$44\% = \frac{x \times 18}{65 + 32 + 64 + x \times 18} \times 100$$

$$x = 7$$



Q. Percentage of Se in peroxidase anhydrase enzyme is 0.5% by weight (at weight = 78.4), then minimum molecular weight of peroxidase anhydrase enzyme is

A 1.568×10^3

C 15.68

B 2.168×10^4

☒ D 1.568×10^4

$$\% \text{ of Se} = \frac{\text{total Mass of Se}}{\text{M.wt of enzyme}} \times 100$$

$$0.5 \% = \frac{1 \times 78.4}{\text{M.wt}} \times 100$$

$$\therefore \text{M.wt} = \frac{78.4 \times 100}{0.5} = \underline{15680} = 1.5 \times 10^4$$



Q.

Haemoglobin contains 0.33% of iron by weight. The molecular weight of haemoglobin is approximately 67200g. The number of iron atoms (at. Weight of Fe is 56) present in one molecule of haemoglobin are

A

1

56 xx 76%

C

6

☒ B

4

D

2

$$\% \text{ of Fe} = \frac{\text{total Mass of Fe}}{\text{M.wt of Hemo}^m} \times 100$$

$$0.33 = \frac{x \times 56}{67200} \times 100$$

$$x = 4$$



Q.

Percentage of oxygen in carbon oxide (C_3O_x) is 47.05% , calculate the value of x

$$12 \times 3 = 36$$

$$16 \times x = 16x$$

$$1 \rightarrow 16, x - (16x)$$

20 Sec → Ans hai 20 $\frac{36+16x}{100}$

A

1

B

4

28%

C

6

D

2

43%

$$\% \text{ of oxygen} = \frac{\text{total Mass of oxygen}}{\text{M.wt of } C_3O_x} \times 100$$

$$47.05\% = \frac{x \times 16}{3 \times 12 + x \times 16} \times 100$$

$$= \frac{16x \times 100}{36 + 16x}$$

$$47.05 \times 36 + 47.05 \times 16x = 1600x$$

$$847.2x = 47.05 \times 36$$

$$x = 1.99$$

$$x = 2$$



EMPIRICAL FORMULA

$$C_{SD} = 22$$

simplest minimum molar ratio of atoms in molecule is known as Empirical formula.

$$\rightarrow \frac{\text{Mass}}{\text{m.wt}}, \frac{\text{Mass}\%}{\text{M.wt}}, \frac{\text{Number}}{N_A}, \frac{\text{Vol. of gas at S.T.P.}}{22.4}$$

$$\rightarrow \text{Mass ratio} \rightarrow w_1 : w_2 \Rightarrow \frac{w_1}{\text{M.wt}_1}, \frac{w_2}{(\text{M.wt})_2}$$



Q - 4 mole A and 6 mole atom B present in a molecule.
Calculate Empirical formula.

(a) AB

(b) AB₂

(c) A₂B

✓✓ (d) A₂B₃

Solⁿ ⇒

A : B

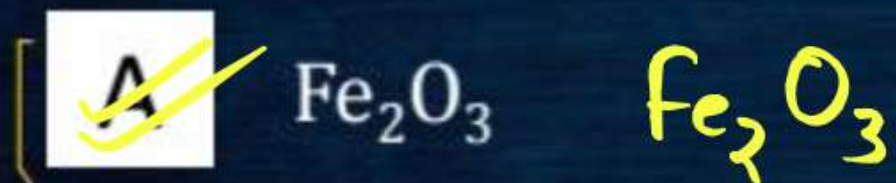
4 : 6

2 : 3

A₂B₃



Q. Determine the empirical formula of an oxide of iron which has 69.9% iron and 30.1% oxygen by mass.



$\rightarrow 1.25 : 1.88$

$\rightarrow \frac{1.25}{1.25} : \frac{1.88}{1.25}$

$(1 : 1.5) \times 2$
 $2 : 3$

$\text{Fe} = \frac{69.9}{56} = 1.25$

$\text{O} = \frac{30.1}{16} = 1.88$



Q Mass % of 'S' and 'O' in sulphur oxide is 50% and 50% respectively. Calculate Empirical formula of sulphur oxide

- (a) SO_3
- ✓ (b) SO_2
- (c) S_2O_3
- (d) S_2O

Solⁿ $\Rightarrow$ $\text{S} = \frac{50}{32}$
 $\text{O} = \frac{50}{16}$

$\text{S} : \text{O}$
 $\frac{50}{32} : \frac{50}{16}$
 $\frac{1}{32} : \frac{1}{16}$
 $\frac{1}{2} : 1$

$\text{S} : \text{O}$
 $1 : 2$
 $\text{S}_1\text{O}_2 = \text{SO}_2$



Q.

A Compound contains 32.4% carbon, 5.4% Hydrogen, 43.2% Oxygen and 19% Nitrogen by mass. Empirical formula of compounds is

A



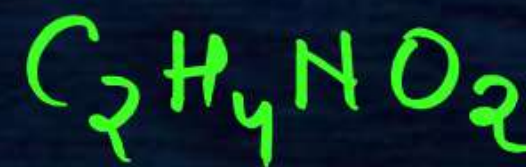
☒ C



B



D

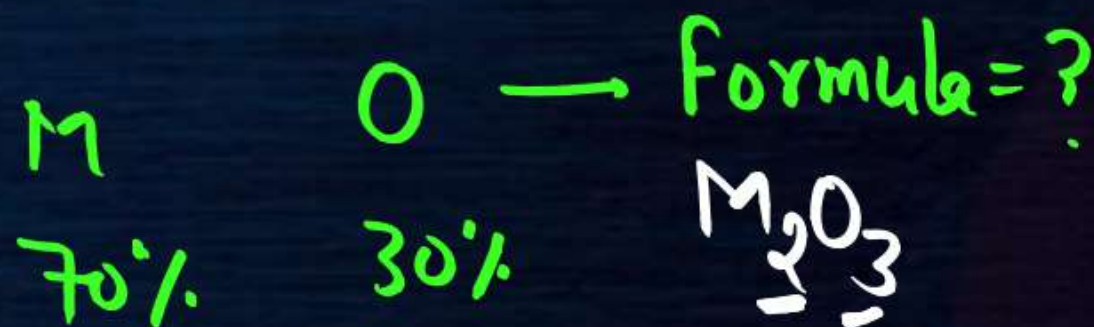
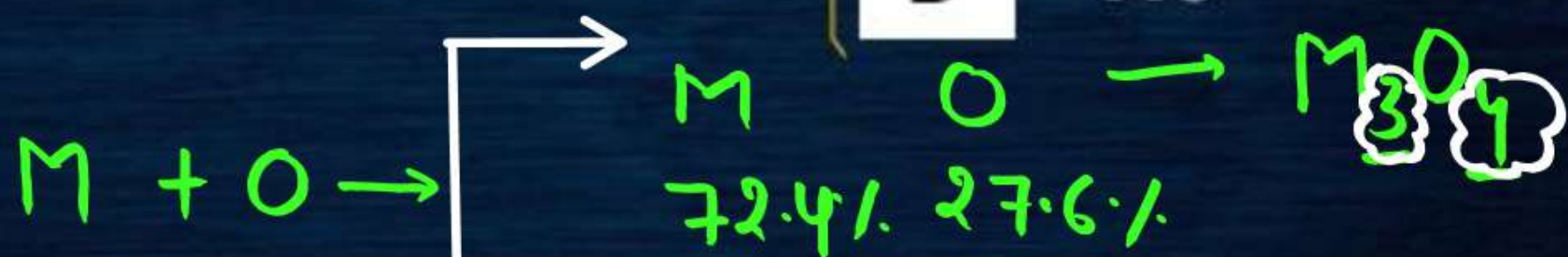


$$\begin{aligned} \text{C} : & \quad \text{H} : & \quad \text{O} : & \quad \text{N} \\ \frac{32.4}{12} : & \quad \frac{5.4}{1} : & \quad \frac{43.2}{16} : & \quad \frac{19}{14} \\ 2.7 : & \quad 5.4 : & \quad 2.7 : & \quad 1.35 \\ \frac{2.7}{1.35} : & \quad \frac{5.4}{1.35} : & \quad \frac{2.7}{1.35} : & \quad \frac{1.35}{1.35} \\ 2 : & \quad 4 : & \quad 2 : & \quad 1 \end{aligned}$$



Q.

Two oxides of a metal contain 27.6% and 30.0% of oxygen respectively. If the formula of the first oxide is M_3O_4 , what will be the formula of the second oxide:



$\frac{72.4}{A}$

$\frac{27.6}{16}$



$\frac{70}{A.wt} : \frac{30}{16}$

$\frac{70}{56} : \frac{30}{16}$

$1.25 : 1.88$

$\frac{1.25}{1.25} : \frac{1.88}{1.25}$

$1 : 1.504$
 $(1 : 1.504) \times 2$





$$\frac{M}{O} = \frac{3}{4}$$

$$\left(\frac{\frac{72.4}{A}}{\frac{27.6}{16}} \right) = \frac{3}{4}$$

$$\frac{72.4 \times 16}{27.6 \times A} = \frac{3}{4}$$

$$A = \frac{72.4 \times 16 \times 4}{27.6 \times 3} = 56$$



MOLECULAR FORMULA

Actual simple molar ratio of atom in a molecule

Compound	M.F.	E.F
① → glucose	$C_6H_{12}O_6$	$C_1H_2O_1 = (CH_2O) \times 6$
② → Hydrogen peroxide	H_2O_2	$H_1O_1 = (HO) \times 2$
③ → Water	H_2O	$H_2O = (H_2O) \times 1$
④ → Benzene	C_6H_6	$CH = (CH) \times 6$



$$\text{Molecular formula} = n \times \text{Empirical formula}$$

$$\text{where } n = 1, 2, 3, 4, \dots$$

$$n \neq 0$$

$$n \neq \text{fractional}$$

$$n = \frac{\text{M.F.}}{\text{E.F.}} = \frac{\text{M.wt}}{\text{Mass of Empirical formula}}$$

$$n = \frac{180}{30}$$

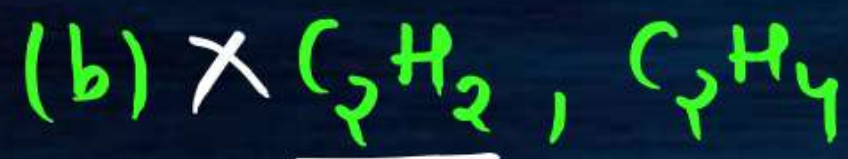
$$n = 6$$

$$\text{Ex} = \begin{array}{l} \text{glucose} \rightarrow \text{M.wt} = 180 \\ \text{Empirical f. of glucose} \rightarrow \text{CH}_2\text{O} = 12 + 2 + 16 = 30 \end{array}$$



Q.

Hydrocarbon contains C = 92.3% and H = 7.7% approx. Calculate Empirical formula of Hydrocarbon. If molecular weight of Hydrocarbon is 78, then find out molecular formula respectively.



Solⁿ ⇒



Empirical formula = C₁H₁

Wt. of Emp. f = 12 + 1 = 13

$$n = \frac{78}{13} = 6$$

$$\begin{aligned} \text{M.f.} &= n \times \text{E.f.} \\ &= 6 \times (\text{CH}) \\ &= \underline{\text{C}_6\text{H}_6} \end{aligned}$$



Q Carbohydrate Contains, $C = 40\%$, $H = 6.67\%$ and $O = 53.34\%$
 approx. Calculate Molecular formula of Carbohydrate, If
 M.wt of Carbohydrate is 180.



Solⁿ



$$\frac{40}{12} : \frac{6.67}{1} : \frac{53.34}{16}$$

$$3.33 : 6.67 : 3.33$$

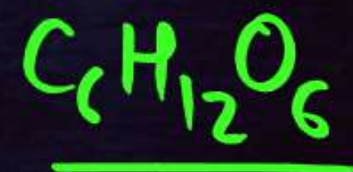
$$\frac{3.33}{3.33} : \frac{6.67}{3.33} : \frac{3.33}{3.33}$$

$$1 : 2 : 1$$

$$C_1H_2O_1 = 12 + 2 + 16$$

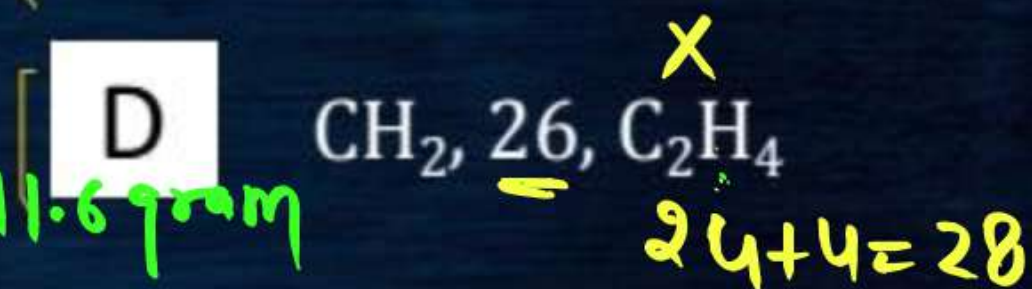
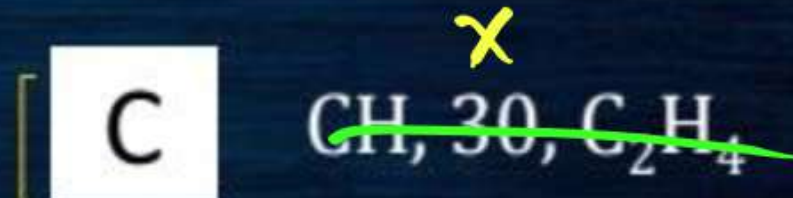
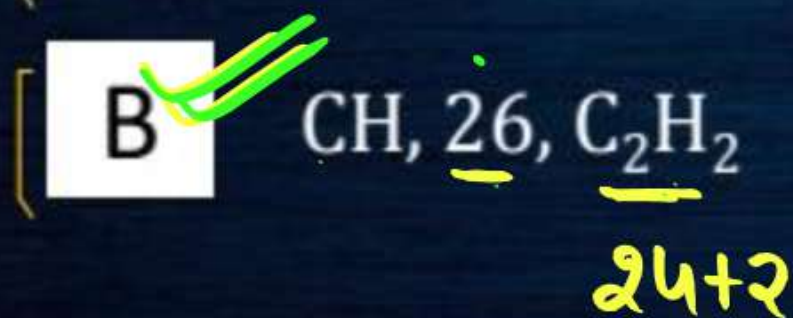
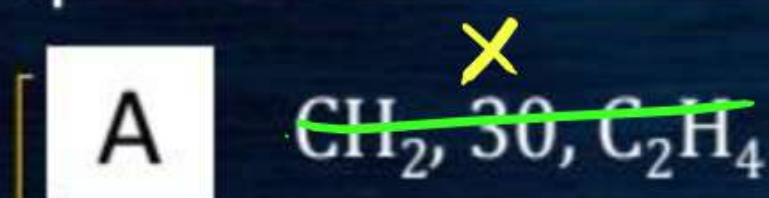
$$n = \frac{180}{30} = 6$$

$$M.F. = (CH_2O) \times 6$$



Q.

A welding fuel gas contains carbon and hydrogen only. Burning a small sample of it in oxygen gives 3.38 g carbon dioxide. 0.690 g of water and no other products. A volume of 10.0 L (measured at STP) of this welding gas is found to weigh 11.6 g. The empirical formula, molar mass of the gas and molecular formula will be respectively.



$$10 \text{ L at S.T.P.} = 11.6 \text{ gram}$$

$$22.4 \text{ L} - \frac{11.6}{10} \times 22.4 = \underline{26 \text{ gram}}$$

$$\text{M.wt of welding fuel gas} = \underline{26}$$



Home work

DPP-06



Thank - You

